



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

MINOR STUDIES FROM THE PSYCHOLOGICAL LABORATORY OF VASSAR COLLEGE

X. A STUDY OF RETINAL RIVALRY IN THE AFTER-IMAGE

By ALMA DE VRIES and MARGARET F. WASHBURN

If a stereoscopic slide be constructed having on each half a small square of differently colored paper, and if such a slide be looked at through a stereoscope from which the middle partition has been removed, double images of each square will be seen. If the distance between the squares has been properly adjusted, the two innermost images will coincide, producing a binocular image that fluctuates in color, displaying the ordinary phenomena of retinal rivalry. Now, when after prolonged fixation of the central square, the eyes are closed, negative after-images of the colored squares appear. The two images on either side show each in the color complementary to that of the square on its side of the slide; the middle image alternates between the colors complementary to those which alternated in the middle square seen on the slide. In other words, the retinal rivalry continues in the negative after-image. For instance, if the slide has a blue square and a red square on it, when seen through the stereoscope it will show three squares, a blue and a red one on either side and in the middle a square which is alternately blue and red; the negative after-image shows a yellow square in place of the blue one, a green square in place of the red one, and in the middle a square which alternates between yellow and green.

There is, of course, nothing remarkable about this phenomenon. Attention was called to it by Breese in his work on Inhibition. Working with a light of approximately constant intensity transmitted through red and green gelatine, he found (1), that "the rate of fluctuation in the rivalry of after-images is much slower than in the case of direct stimulation;" and (2), that the lengths of the phases varied on different days. Seven tests only were made, and the duration of fixation of the stimuli was one hundred seconds. Breese found also, as a result of his study of rivalry in general, that conscious effort increased the length of time during which the phases seen with open eyes lasted. But he did not observe what effect such 'voluntary' lengthening of phase had upon the phase of the corresponding negative after-image, and it was to this problem that we addressed ourselves in the work to be described.

Our method of experiment was as follows: The observer looked through the stereoscope for forty seconds at a slide on which were two squares, one of green paper and one of blue paper, the saturated green and blue of the Bradley series. These squares were one cm. a side. The observer's hand rested on a telegraph key, by pressing down which the line drawn by an electric marker on a smoked drum was lowered. Time was registered on the drum by a Jacquet time-marker. The light was ordinary daylight, which of course varied in intensity; the experiments were always performed at the same time of day. During the forty seconds' fixation the observer recorded the time of the fluctuations of the middle image by means of the key, while the experi-

menter recorded on the drum the nature of the changes as verbally reported by the observer. The experimenter at the end of forty seconds gave a 'Now' signal, at which the observer closed her eyes and the fluctuations of the middle after-image were recorded in the same way as those of the original image. After completing such an experiment, a rest of three minutes was allowed. The after-image, it should be said, was observed as long as any trace of it remained. When three minutes had elapsed, the experiment was repeated, but this time the observer was instructed to make every effort to hold the blue color in the middle image during the period of actual stimulation. When the eyes were closed, the after-image was allowed to take its course as before without effort at control, the object being to see whether any lengthening of the blue phase by effort in the original image would affect the duration of the yellow phase in the after-image. Another three minutes' pause was then allowed, and a third experiment performed in which it was attempted to prolong the green phase in the original image. These three experiments were usually all that were demanded of the observer during a sitting, as the work was quite fatiguing. From six to ten such complete experiments, of three parts each, were made with each of the three observers. Later, the colors red and blue were used on the cards, five complete experiments being made with each observer. The observers were V. and W., the writers, and R., a young woman with a semester's previous training in introspection.

The numerical results appear in the accompanying tables. The first horizontal row, under each observer, marked 'Uncon.', gives the average figures for the experiments where there was no effort to control the rivalry in the original image; the second horizontal row in Table I gives the average results for the experiments where the observer attempted to prolong the blue phase, and the third row those where the attempt was to prolong the green phase. In Table II the second and third horizontal rows give the results of effort to control for blue and red respectively. 'L' stands for the average duration in seconds of each appearance of the color under which it is placed; 'N' for the average number of such appearances. 'M. V.' of course refers to the mean variations of these averages.

The conclusions to be drawn from these tables may be briefly stated as follows:

(1.) In the rivalry of the original stimuli an effort to see either one of the two colors resulted in a lengthening of the average duration of the appearances of that color. The average length of the phase of a given color was longer when the effort was made to hold that color, in every case but two. In one of these exceptions, observer W., when the effort was made to hold the red phase against the blue, obtained an average red phase (2.2 seconds) which was longer than was the case when the series was controlled for blue, but shorter than the red phase in the experiments without attempt to control (4.7). The other exception occurred with observer R., who in the experiments with red and blue got a shorter average phase when she attempted to hold red than under any other circumstances. In the other ten sets of experiments where there was attempt to control, the attempt was successful so far as a lengthening of the average duration of the separate appearances of the colors was concerned. This result is in accord with those of Breese.

(2.) Another of Breese's results is also confirmed. He says, "The rate of fluctuation in the rivalry of after-images is much slower than in the case of direct stimulation." We also find that the average

length of a color phase is longer in the after-images than in the original images.

(3.) A third confirmation of Breese's results relates to his statement that by effort to hold one color in the original image, "the number of fluctuations in the rivalry could not be controlled." Inspection of our tables shows that in every case but two, the number of appearances of a given color was not increased by the effort to see that color, although the duration of the single appearances was. It is a curious coincidence, at least, that the two exceptions are identical with the exceptions to the increase of average phase with effort. Observer W., who did not get a maximum average red phase with the effort to hold red against blue, got the maximum number of appearances of the red phase under these conditions; and observer R., who got the minimum average length of the red phase in trying to hold red against blue, also found that the effort in this direction produced the greatest number of appearances of red. It looks almost as though the effort to control, which normally lengthens the time of each appearance without affecting the number of appearances, might on failing to produce the first effect expend its energy in bringing about the second.

(4.) It will be seen on comparing the figures that when through the effort to hold one color, the average duration of that color in the original image was lengthened, the negative after-image of the color in question was not seen any longer than when no effort at control was made. The lengthening of a color phase in the original image by effort to hold that color is accompanied, in general, by no correspond-

TABLE I
Colors: Green and Blue

		Observer W															
		STIMULUS								AFTER-IMAGE							
		GREEN.				BLUE.				RED				YELLOW			
		L	m v	N	m v	L	m v	N	m v	L	m v	N	m v	L	m v	N	m v
Uncon.		1.3	.45	9.	1.5	1.7	.22	9.5	1.	3.2	1.3	2.	.5	5.6	2.1	1.2	.3
Blue		1.2	.22	9.5	1.	2.2	.15	9.5	1.5	3.7	.8	1.5	.75	7.4	2.3	2.2	1.6
Green		1.5	.4	9.5	2.5	2.1	.55	9.2	1.8	3.3	.7	1.5	.5	9.5	3.4	2.7	1.7
		Observer V															
Uncon.		2.2	.27	8.5	1.8	2.3	.8	8.7	1.5	3.3	1.3	3.2	.65	3.3	.9	3.8	1.1
Blue		1.1	.26	7.	1.6	4.4	1.2	7.4	1.4	2.4	1.5	2.7	1.1	3.7	1.3	2.7	.8
Green		3.8	.9	7.8	1.7	1.3	.58	7.2	1.2	4.2	1.2	1.9	.36	2.6	.7	2.1	.5
		Observer R															
Uncon.		1.6	.47	11.	1.9	2.5	.87	9.9	1.9	1.8	.65	2.8	1.5	3.4	1.4	6.6	1.4
Blue		1.4	.34	9.7	1.5	2.7	.6	9.4	1.3	2.5	.97	2.2	.84	3.2	.78	5.9	1.5
Green		2.2	1.	10.1	1.3	1.8	.29	9.4	1.6	2.5	.98	2.4	.56	3.4	.56	6.	1.4

TABLE II
Colors: Red and Blue

Observer W																
	STIMULUS								AFTER-IMAGE							
	Red				Blue				Green				Yellow			
	L	m v	N	m v	L	m v	N	m v	L	m v	N	m v	L	m v	N	m v
Uncon.	4.7	1.8	5.4	.7	2.2	.9	5.	.8	6.3	1.	2.6	.48	4.9	1.5	1.8	.38
Blue	1.8	.32	7.	.8	<u>2.7</u>	.5	6.8	1.	4.6	.7	2.4	.48	<u>4.7</u>	.8	1.8	1.1
Red	2.2	.42	7.8	1.	1.6	.28	7.6	.88	<u>5.1</u>	1.2	2.6	.48	<u>6.</u>	2.5	2.4	.48
Observer V																
Uncon.	1.8	.58	8.6	1.2	1.8	.24	8.6	1.2	6.1	1.9	6.1	1.1	2.4	.44	3.8	.64
Blue	1.2	.22	6.	.84	.48	7.	1.5	4.2	1.	6.	1.	<u>2.8</u>	.78	3.2	.64	
Red	<u>3.</u>	.76	7.	1.6	<u>2.</u>	.68	7.	2.	<u>4.5</u>	1.1	5.2	.8	<u>2.8</u>	.8	1.6	.48
Observer R																
Uncon.	2.9	.84	9.	.8	2.1	.78	8.2	.64	3.5	1.2	5.8	1.5	3.4	.98	6.	2.
Blue	2.9	.62	7.4	1.5	<u>2.3</u>	.54	8.2	1.2	3.2	.26	5.2	2.1	<u>2.6</u>	.32	5.1	1.6
Red	<u>2.5</u>	.53	9.6	1.	1.5	.6	9.4	1.1	<u>3.1</u>	.37	5.8	1.7	<u>3.9</u>	.63	4.4	1.6

ing lengthening of the negative after-image of that color. Only two out of the twelve sets of experiments show any trace of such an effect on the after-image. These are the experiments of observer V., with blue and green, which do give a lengthening of the after-image phase corresponding to the control of the original image. As observer V. was the most successful of the three observers in controlling rivalry, it may be that very complete control of the rivalry in the original image might carry with it an effect on the after-image. V.'s control in the red and blue experiments, however, was just as good, and here there was no influence on the after-image.

On the whole, these results are such as we should expect if motor processes condition rivalry. Evidently, when an observer is directed to make an effort to hold a certain color, there is an amount of muscular strain, in addition to the eye-movements which Breese observed under such circumstances, sufficient to make the motor conditions quite different from what they are when the rivalry is merely observed in a passive attitude. As this latter was the attitude during the course of the after-image, it is only natural that there should be little or no correspondence between the phases of original image and after-image.

Another question which demands an answer is this: What is the duration of the average phases in the *uncontrolled* original image, as compared with that of the average phases of their corresponding after-images? The tables show that in the averages there was a certain amount of concomitant variation. A survey of the first horizontal line of figures under each observer indicates that when in uncontrolled rivalry the red phase, for instance, was on the average longer than

the blue phase, the average green phase in the after-image was longer than the yellow one. While this is true of the averages, the detailed records show that it was not true in a majority of the individual experiments, which rather oftener than not fail to point to any correspondence. Perhaps the nearer approach to correspondence between original image and after-image shown in the uncontrolled experiments may be due to the fact that the motor conditions were here more nearly alike in the two halves of an experiment, where no special effort was made in either half; while the fact that a perfect correspondence is very far from existing even in the uncontrolled series may be accounted for by the difference in motor conditions, such as convergence, for example, that must still exist between the part of an experiment where the observer with open eyes looks through a stereoscope, and the part where he watches the after-image changes with closed eyes.